

3. Report on the Deaths which occurred in the Zoological Gardens during 1916, together with a List of the Blood-Parasites found during the Year. By H. G. PLIMMER, F.R.S., F.Z.S., Professor of Comparative Pathology in the Imperial College of Science and Technology, London, and Pathologist to the Society.

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On January 1st, 1916, there were 690 mammals, 1989 birds, and 426 reptiles in the Zoological Gardens: during the year 1916, 165 mammals, 545 birds, and 199 reptiles were admitted, making a total for the year of 855 mammals, 2534 birds, and 625 reptiles.

During 1916, 242 mammals, 594 birds, and 179 reptiles have died: that is, a percentage of 28·3 for mammals, 23·4 for birds, and 28·6 for reptiles: the average percentages for the last five years being 27, 23·3, 31·2 respectively.

Out of the total deaths for the year, 1015 in all, 269 occurred in animals which had been less than six months in the Gardens, that is a little more than a fourth of the deaths. It has been found that after six months' residence in the Gardens the death-rate of the animals falls rapidly; so it is assumed that by this time the new arrivals have got used to their new environment, or have died from any diseases of a parasitic kind which they may have brought with them. Of these 269 animals 60 were mammals, 132 were birds, and 77 were reptiles; and, if these be deducted from their respective totals, the death-rate percentage will come out as 21·2 for mammals, 18·1 for birds, and 16·3 for reptiles, the average percentages for the last five years being 17·3, 15·6, 13·8 respectively.

The following Tables show in outline the facts which have been ascertained. Table I. summarizes the actual causes of death in the three groups specified. Amphibia are included under Reptiles.

TABLE I.—Analysis of the Causes of Death.

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
1. <i>Microbic or Parasitic Diseases.</i>				<b>1</b>
Tuberculosis .....	16	71	1	<b>2</b>
Mycosis .....	12	29	6	<b>3</b>
Pneumonia .....	30	53	48	<b>4</b>
Septicæmia .....	5	...	1	<b>5</b>
Abscess .....	2	...	1	
Empyema .....	2	...	...	
Peritonitis .....	2	1	...	

TABLE I.—Analysis of the Causes of Death (*continued*).

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
<b>1. <i>Mycobiotic or Parasitic Diseases (cont.)</i></b>				
Cystitis .....	1	...	1	
Leucocytotozoa infection.....	...	1	...	
Acari infection .....	...	1	...	6
Syngamus infection .....	...	1	...	
Filariasis .....	1	...	...	
Ascariidosis .....	2	...	1	7
<b>2. <i>Diseases of Respiratory Organs.</i></b>				
Atelectasis .....	5	...	...	} 8
Bronchitis .....	8	...	...	
Broncho-pneumonia .....	42	...	...	
Congestion of lungs .....	3	78	8	
Pleuritis .....	1	...	...	
<b>3. <i>Diseases of the Heart.</i></b>				
Degeneration of muscle .....	1	1	...	
<b>4. <i>Diseases of the Liver.</i></b>				
Hepatitis .....	...	1	2	
Cirrhosis .....	4	2	...	
Fatty degeneration .....	...	3	1	
<b>5. <i>Diseases of the Alimentary Tract.</i></b>				
Gastro-enteritis .....	4	2	2	} 9
Gastric ulceration .....	2	...	...	
Enteritis .....	22	190	14	
Gastritis .....	...	...	3	
Intestinal obstruction .....	...	1	...	
Intussusception .....	2	...	...	
Prolapse of rectum .....	1	...	...	
<b>6. <i>Diseases of Urinary and Generative Organs.</i></b>				
Nephritis .....	34	45	5	10
Cystic kidneys .....	...	1	...	
Salpingitis .....	...	1	3	
Extroversion of uterus .....	1	...	...	
<b>7. <i>Various.</i></b>				
Carcinoma .....	3	...	...	11
Sarcoma .....	2	1	...	12
Leukæmia .....	1	...	...	13
Caries of spine .....	1	...	...	
Spinal curvature .....	1	...	...	
Hæmorrhage .....	...	1	...	
Injuries discovered <i>post-mortem</i> .....	...	1	...	14

Besides those tabulated above,

25 mammals, 85 birds, 7 reptiles, were killed by order or by companions,

1 bird, 37 reptiles, died from malnutrition or starvation,

6 mammals, 22 birds, 38 reptiles were too decomposed for examination,

1 bird was preserved unopened,

completing the total.

In Table I. an analysis is made of the immediate causes of death, but in nearly every case the animals were found to be suffering from other lesions as well. Table II. summarizes these other diseases from which the animals were suffering; and if this Table be taken in conjunction with Table I., a much more accurate estimate of the amount of disease in the Gardens will be arrived at.

TABLE II.—Secondary Diseases found in the animals tabulated in Table I.

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
Tubercle .....	1	...	...	} 15 16
Mycosis .....	...	...	2	
Pneumonia .....	2	6	...	
Pericarditis .....	1	...	...	
Peritonitis .....	5	2	3	
Abscess .....	2	...	1	
Pyorrhœa .....	3	...	...	
Hydatids .....	1	...	...	
Worm infection .....	1	3	3	
Malaria .....	...	4	...	
Filaria .....	1	2	...	
Hæmogregarines .....	...	...	4	
Leucocytozoa .....	...	1	...	
Stomatitis .....	...	...	3	
Bronchitis .....	6	...	...	} 17 18
Broncho-pneumonia .....	11	...	...	
Congestion of lungs .....	20	162	16	
(Edema of lungs .....	1	103	8	
Collapsed lungs .....	1	...	...	
Degeneration of heart .....	4	1	1	
Hypertrophy of heart .....	1	...	...	
Hepatitis .....	...	1	...	
Pericarditis .....	...	5	...	
Atheroma of aorta .....	3	4	...	
Aneurism .....	1	...	...	
Fatty degeneration of liver .....	17	41	5	
Cirrhosis of liver .....	3	1	1	
Cholecystitis .....	1	...	...	
Gastritis .....	3	...	1	
Gastric ulceration .....	9	...	...	
Gastro-enteritis .....	5	...	4	
Enteritis .....	28	90	14	
Intestinal obstruction .....	...	1	...	
Nephritis .....	36	78	7	
Cystic kidneys .....	1	2	...	
Salpingitis .....	...	2	...	
Ascites .....	...	...	2	
Angioma .....	1	...	...	
Lardaceous disease .....	1	...	...	
Retained fœtus .....	1	...	...	
Ricketts .....	2	...	...	
Uræmia .....	1	...	...	
Injuries .....	1	5	...	

Table III. shows, in still further detail, the distribution of the immediate causes of death, shown in Table I., amongst the various large orders of mammals.

TABLE III.—The Distribution of Diseases causing Death amongst the principal Orders of Mammals.

Diseases.	Primates.	Carnivora.	Rodentia.	Ungulata.	Edentata.	Marsupialia.
Tuberculosis .....	7	4	1	2	...	2
Mycosis .....	1	...	1	6	...	4
Pneumonia .....	11	7	9	1	...	2
Septicæmia .....	...	3	1	...	...	1
Abscess .....	1	...	1	...	...	...
Empyema .....	...	2	...	...	...	...
Peritonitis .....	1	...	1	...	...	...
Cystitis .....	...	1	...	...	...	...
Filariasis .....	...	...	1	...	...	...
Ascariidosis .....	...	2	...	...	...	...
Atelectasis .....	...	4	...	1	...	...
Bronchitis .....	2	...	3	1	...	...
Broncho-pneumonia .....	21	9	8	4	...	...
Congestion of lungs .....	...	...	2	1	...	...
Pleuritis .....	...	...	...	...	1	...
Degeneration of heart .....	1	...	...	...	...	...
Cirrhosis of liver .....	...	2	...	...	...	2
Gastro-enteritis .....	3	1	...	...	...	...
Gastric ulceration .....	1	...	1	...	...	...
Enteritis .....	8	2	9	2	...	1
Intussusception .....	2	...	...	...	...	...
Prolapse of rectum .....	...	...	...	...	...	1
Nephritis .....	12	10	4	5	2	1
Extroversion of uterus .....	...	...	1	...	...	...
Carcinoma .....	...	2	1	...	...	...
Sarcoma .....	...	1	1	...	...	...
Leukhæmia .....	...	1	...	...	...	...
Caries of spine.....	1	...	...	...	...	...
Curvature of spine .....	1	...	...	...	...	...

The following, Table IV., shows the number of Deaths from those Diseases of the greatest numerical importance for the last four years: the total number of animals of each class is placed above, so that a proper comparison can be made.

TABLE IV.

*Mammals.*

Year .....	1913.	1914.	1915.	1916.
Total number of mammals ...	1272	1261	1013	855
<i>Mammals.</i>				
Tuberculosis .....	31	12	6	16
Mycosis .....	8	6	10	12
Pneumonia .....	34	53	48	30
Bronchitis .....	6	11	10	8
Broncho-pneumonia .....	25	24	34	42
Congestion of lungs .....	14	14	13	3
Gastro-enteritis .....	7	16	11	4
Enteritis .....	33	33	25	22
Nephritis .....	90	66	40	34
<i>Birds.</i>				
Total number of birds .....	3518	3610	3240	2534
Tuberculosis .....	104	113	60	71
Mycosis .....	75	88	32	29
Pneumonia .....	89	118	70	53
Congestion of lungs .....	98	133	130	78
Enteritis .....	148	169	150	190
Nephritis .....	135	129	81	45
<i>Reptiles.</i>				
Total number of reptiles .....	1169	1045	608	625
Tuberculosis .....	6	4	2	1
Mycosis .....	1	10	6	6
Pneumonia .....	138	69	34	48
Congestion of lungs .....	13	19	11	8
Enteritis .....	15	17	8	14

## BLOOD-PARASITES.

During the year the blood of every animal mentioned in the foregoing lists has been examined, with the result that parasites have been found in 24 cases, in 13 species for the first time.

They have been distributed as follows :—

*Filarice.* In 3 mammals; in all for the first time.

In 3 birds; in all for the first time.

*Malaria.* { *Haemoproteus danilewskyi.* In 5 birds; in 3 species  
for the first time.  
*Plasmodium præcox.* In 1 bird for the first  
time.

*Leucocytozoa.* In 3 birds; in 2 species for the first time.

*Hæmogregarines.* In 9 reptiles; in 3 species for the first time.

*Intestinal organisms.* In 1 reptile.

The particulars of the blood-parasites are as follows :—

*Filariae.*

*Mammals.*

<i>Found for the first time in :</i>	HABITAT.	TYPE.
Bay Lynx ( <i>Felis rufa</i> ) .....	Mexico.	Long.
Hamster ( <i>Cricetulus obscurus</i> ) .....	Mongolia.	Long, thick.
Grison ( <i>Grison allamandi</i> ).....	Argentina.	Long.

*Birds.*

Scarlet Cardinal (*Cardinalis phoeniceus*). Venezuela.

*Found for the first time in :*

Black-headed Sugar-Bird ( <i>Chlorophanes spiza</i> ).	Brazil.	Short, thick.
Gay's Finch ( <i>Phrygilus gayi</i> ) .....	Chili.	Long, no capsule.

*Malaria.*

*Birds.*

Hæmoproteus danilewskyi.

Paradise Whydah Bird (*Vidua paradisæ*). W. Africa.

Shama (*Cittocincla macrura*) .....
 India. |

*Found for the first time in :*

Rose Finch ( <i>Propasser rhodochrous</i> ) ...	India.
Yellow-backed Lory ( <i>Lorius flavo-palliatu</i> s).	Batchiam.
Scarlet Cardinal ( <i>Cardinalis phoeniceus</i> ).	Venezuela.

Plasmodium præcox.

*Found for the first time in :*

Pitta (*Pitta nova-guinæ*).....
 Aru Islands. |

*Leucocytozoa.*

*Birds.*

Scops Owl (*Scops giu*) .....
 Captured at sea. |

*Found for the first time in :*

Rose Finch ( <i>Propasser rhodochrous</i> ) ...	India.
Carrion Crow ( <i>Corvus corone</i> ) .....	Europe.

*Hæmogregarines.*

*Reptiles.*

Common Boa ( <i>Boa constrictor</i> ).....	S. America.
King Snake ( <i>Coronella getula</i> ) .....	N. America.
Banded-tailed Tree-Snake ( <i>Leptophis viperinus</i> ).	Europe.
Indian Python ( <i>Python molurus</i> ) .....	India.
Eyed Lizard ( <i>Lacerta ocellata</i> ) .....	Europe.

<i>Found for the first time in :</i>	HABITAT.	TYPE.
Annulated Snake ( <i>Leptodira annulata</i> ).	S. America.	Stout.
2 Burrowing Boas ( <i>Bryx thebaicus</i> ) .....	Gold Coast.	Ordinary size.
Ocellated Bladder-frog ( <i>Leptodactylus ocellatus</i> ).	Argentina.	Long, thick.

### *Intestinal Organisms.*

#### *Reptiles.*

Viperine Snake ( <i>Tropidonotus viperinus</i> ).	Europe.	Amœbæ.
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### NOTES ON THE FOREGOING.

1. The total incidence of microbic and parasitic diseases causing death in the Gardens for 1916 is 8·5 per cent. in mammals, 6·1 per cent. in birds, and 9·4 per cent. in reptiles. If those cases which have not lived six months in the Gardens be excluded, these percentages will be greatly reduced.

2. The numbers of deaths from tuberculosis amongst the mammals and birds show a relative increase, the incidence being 1·8 per cent. in mammals and 2·8 per cent. in birds. Amongst the mammals dying from tuberculosis, 16 in all, 7 were Monkeys, and of these 5 had been pet animals; of the remaining 9 animals 4 had been pets. These figures seem to me to indicate quite plainly that pet animals should not be accepted by the Society, or only after the strictest quarantine. An Orang Utan which had been 8½ years in the Gardens had chronic tubercle of human type, which he might very well have brought with him. The most remarkable case this year was in an Ibex which died when about a fortnight old with tubercle of liver, spleen, and mesenteric glands. There is a relative increase this year in the number of deaths from tubercle amongst the birds, and in a much larger relative number were the lesions generalized, namely in 36, indicating a more severe type of the disease. The one reptile was an Alligator in which the disease was of human type, and was no doubt caused by the habit of certain visitors of spitting at the animals, to which I have often called attention in previous reports.

3. As usual I have grouped all the diseases caused by moulds under mycosis. In the mammals six of the cases were of the ordinary type, associated with abscesses; and in six, tumours (mycetomata) in various organs were present. In a sheep the growth began in the cavities of the nose and spread into the adjacent bone-spaces. There is a slight relative increase amongst the birds, but there are now less than half the number of cases there were a few years ago. In one Parrot it was caused by *Aspergillus niger*. Three of the six reptiles died with mycotic tumours in various parts.

4. The incidence of pneumonia remains about the same as last year amongst the mammals and birds. In one bird it was

due to trematodes and in three reptiles to worms, otherwise it was pneumococcal. There has been a slight increase amongst the reptiles.

5. The septicæmias were due to abscesses in two cases, to extensive ulceration in two, and in one to a decomposing fœtus.

6. This rare infection of the lungs and air-sacs of a Pheasant from Mongolia has been noticed only once before in the Gardens, in a Haugnest from La Plata. The mite was a *Cytolæichus*.

7. In these cases of nematode worm infection the lesions produced were very different; in a Lynx they caused a pseudo-tubercle of the liver, in a Puma they caused perforation of the stomach-wall and peritonitis, and in a Toad they produced a pneumonia.

8. There has been relatively a small increase in the diseases of the respiratory organs amongst the mammals. They are, of course, largely dependent on weather, and 26 of the cases of broncho-pneumonia occurred in the last two months of the year, during bad external conditions. Among the birds there has been a considerable relative decrease in the deaths from congestion of the lungs.

9. There has been a considerable increase in the number of cases of enteritis amongst the birds, but it has been of a milder type. 54 of the bird cases were hæmorrhagic; in 4 worms were the cause, and in 3 foreign bodies, and 2 were due to amœbæ; during the last three months of the year 28 Parrots have died from that specific kind of enteritis called Psittacosis. Of the cases in mammals, 3 have been hæmorrhagic, 4 associated with ulceration of the intestines, and 1 was caused by foreign bodies. The term enteritis covers all inflammatory diseases of the intestines, and as these are due to so many different causes it may be worth while to mention them. In the Gardens I have found five different varieties, which are due to the following causes: 1. Errors in feeding. 2. Foreign bodies. 3. Worms. 4. Bacteria. 5. Protozoal organisms. Of these causes the first and the fourth are the most important.

10. There has been a considerable relative decrease in the number of cases of nephritis. This word, like enteritis, covers inflammations of the kidney which are due to various causes. Nephritis can be divided, for purposes of classification, into acute and chronic; the former being due to infection, or to exposure, and the latter either following the acute disease, or being due to degenerative changes and associated with cardio-vascular changes, with old-age changes, or the artificial old-age changes induced by captivity. The absence of proper space for exercise must render animals more sensitive to temperature changes, and especially to draughts. 16 of the mammals had acute nephritis, and 18 chronic; only 1 bird had acute nephritis, all the others being chronic; in all the 5 reptiles it was chronic.

11. The three cases of cancer occurred in the liver, spleen, and adjacent glands of an old Bear, in the liver and adjacent organs



and glands of a Cavy, and in the neck of a Wolf. The case of the Wolf is of interest because his father died here in 1914, and his mother in 1915, of the same disease in the same situation. A sister is alive and well.

12. A Coypu died from an angiosarcoma of the liver; it had also an adenoma of the kidneys, and is of interest as being the third case of similar tumour of the liver, and the fifth of similar tumour of the kidneys in Coypus dying in the Gardens during the last 9 years.

13. Of lymphatic variety in a Polecat. This is the second case of this rare disease which has occurred in 9 years.

14. The injury was a ruptured heart in a Flamingo, and is mentioned because it is the fifth Flamingo which has met with the same rare accident.

15. Further details of these blood-parasites will be found under the section "Blood-Parasites," p. 32. Under the term malaria are grouped cases due to *Hæmoproteus danilewskyi* and to *Plasmodium præcox*.

16. These were due to a large *Saccharomyces*.

17. These cases in birds were due to the deposition of masses of crystals (of guanin, probably) in both visceral and parietal pericardium.

18. The only aneurism found this year was in a Civet, of fusiform variety.

19. This rare complication of kidney disease occurred in a Mandrill which had acute upon old nephritis.